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THE UNIVERSITY OF ALBERTA

DETERMINANTS OF COLOR USE



by

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### Abstract

Color preference and color naming of "white" seven-year olds and ten-year olds were tested with Munsell color paper. Color preference was also assessed with "weight-abrasion" method -- the loss of weight (to the nearest 0.001 gm.) of color crayons attributable to drawing. Colors of drawing paper were white, light grey, dark grey, and black. Affective themes of the drawings were judged according to Rychlak.

The order of preference, as tested with actual colors and beginning with most liked colors was: purple, green, red, blue, orange, yellow, light green, turquoise, and dark yellow. The "weight-abrasion" method yielded the order of: blue, turquoise, yellow, light green, green, red, dark yellow, orange, and purple. Red, orange, blue, and purple had high codability, whereas light green, green, dark yellow and turquoise had low codability. Older children and younger boys manifested similar affective themes compared to younger girls. The amount of color used increased, then decreased as the value of the paper decreased.

Correlations between both preferences was low





and negative whereas the correlation between preference (actual colors) and codability was fairly high. Other correlations between colors of crayons and preference, codability, chromatic and lightness contrasts of backgrounds were also low. The colors used in drawings were representative of actual colors in life and not a reflection of color preference, or codability, or chromatic and lightness contrast.





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## Introduction

Color phenomena and functions are systematized by the Committee on Colormetry of the Optical Society of America (1963, p. 220) which defines color as the characteristics of light other than spatial and temporal inhomogenities; light being that aspect of radiant energy of which a human observer is aware through the visual sensations of the eyes. As evidenced by the committee's work (The Science of Color, 1963) all aspects of color are not equally investigated.

In general, color perception is an area that has massive research as indicated by two extensive bibliographies by Richter (1952, 1963) which contain well over 6,000 entries even though they cover only the 15 year period from 1940 to 1954. Out of this enormous body of research, theories of color perception and vision and general classifications have emerged.

Probably the most significant classification of appearance of color is by Katz (1935). He identified five modes of perceiving color: aperture, illuminant, illumination, film and object modes of surface and volume.

The aperture mode is one in which color is seen without regard to its distance or its being a property of surface of any object (color that is seen through





an optical instrument e.g., microscope). The illuminant mode is the one seen when one views a source of photic radiation such as an incandescent filament. The illumination mode is one seen when one detects that the color of a surface is "due to" its illumination (color falling on the object). The film mode is one produced, when photic radiation falls on rapidly moving blades of a fan, or an episcotister and the surface and volume modes are seen when the color seems to be an intrinsic property of the object rather than light falling on it.

Besides aperture mode, the surface mode of color perception is the only one that has been employed much in research, and one of the more workable color nomenclature systems to evolve out of such investigations is the Munsell color system (Munsell Book of Color, 1929). The system defines the three general surface dimensions of color: hue, value and chroma. The three characteristics are built into a three dimensional scheme, ordinarily called a color solid, and has a vertical black-white axis. Radiating from this axis are the hues which are arranged equiangularly. Chroma is the horizontal distance from the axis. The assumed prevailing conditions are that the observer is adapted to daylight, or conditions specified as average north-sky daylight illumination or the illumination provided by a radiating source at approximately 6500°K.



Hue is the attribute of color sensation according to which an observer is aware of differences of wavelengths of radiant energy. It is what is ordinary is known as color. Chroma is the quality of sensation by which an observer is aware of different purities of any one dominant wavelength. Value is the attribute of sensation by which the observer is aware of differences of luminance or luminous intensity.

Relatively few investigations have been conducted to determine the functions and uses of color, though color is routinely used in clinical theory, business, industry, science, theatre and medicine to code and identify objects, and to communicate information and to convey a variety of affective moods. Color use, especially in drawing, is probably a function of color preferences, hue codability and memory, color contrast and background and affect.

### Color Preference

#### Physical appearance

Little has been settled as to what factors influence the physical appearances of color, which in turn affect color preference. Probably the only issue that has been repeatedly confirmed is that saturated colors are preferred over the unsaturated (Cohn 1894, Jastrow 1896, Bradford 1913, Luckiesh 1916, Katz and Breed 1922,





Walton and Morrison 1931, Granger 1955, and Child et al. 1969). Clark, Goodell and Washburn's (1911) confirmation was modified namely that with the exception of red, saturated colors are preferred in small areas, whereas unsaturated are preferred in large areas. Guilford and Smith (1959) find that preference was related to brightness, besides saturation. They generalize that affective value is positively related to brightness and saturation.

The opposite is reported by Minor (1908, and Washburn (1911). In spite of Major's (1895) undecisive results, he concluded that unsaturated colors were preferred. Dorcus (1926) and Arlitt and Buchner (1927) find that saturation or brightness has little effect in determining the preferential order of colors. Titchner (1905) reports that there are two kinds of observers. One kind prefers the saturated and the other, definitely prefers the unsaturated colors, and that the former type constitute the majority. In spite of a few contradictory and inconclusive findings, it can be justifiably concluded that saturated colors are preferred over the unsaturated.

Other factors that influence the physical appearance of color are largely unexplored. Luckiesh's (1916) investigation of the effect of either artificial



light or daylight on color preference, reports no difference in the orders chosen in either illumination. And Rodriquez (1950) who used different forms and sizes of color blocks found that different orders of preference were given depending on the form or size of the block. And the effect of using either a white or black background (Major 1895) was not critical as both backgrounds were found to have a pleasant effect on the preferences.

#### Modes of testing

As in color perception, the surface mode (actual colors) is the one that has been principally employed to test color preference. The illuminant mode (colored lights) seems the only other mode that has been used (Walton and Morrison 1931, Stapes and Walton 1933). Five investigators (Winch 1909, Michaels 1924, Hurlock 1926, Hirohoshi 1926, and Chou and Chen 1935) used color words as testing stimuli. Michaels used actual colors as well, whereas the last two mentioned investigations used a questionnaire to test for color preference of real objects. Eicher, Decher and Shipley (1964) not only used actual colors, but also rated the colors of clothes of the subjects, to compare the two preferences. With a few exceptions, the orders of color preferences obtained with these testing stimuli are the same as those obtained when actual colors were



used as testing material.

### Self-expression

A few investigators have studied color preferences not only as visual appreciation but also as self-expression. Arlitt and Buchner (1927) used doll dressing, painting and drawing to test the color preference of three-year olds. For doll dressing, the investigators recorded the order in which colored silk squares were chosen. In painting and drawing color preference was determined by the order in which paints or colored chalks were chosen and by the number of times each color was used to "make a picture".

Ames and Ilg (1962) used Lowenfeld mosaic text to investigate color preference of children and adolescents. The subjects were given 448 tiles of different shapes and colors (blue, black, red, green, white, and yellow) and were asked to make anything they wished.

Haas (1963) investigated whether color preferences obtained with actual colors (tiles), free painting and a questionnaire were related. For tiles, he used the Lowenfeld mosaic test, and each subject was asked to arrange the tiles in the order of preference. During free painting, the subject was asked to choose a color and paint anything he wanted. For the questionnaire, subjects were asked about the rationale of the order of





colored tiles, factors that influenced the selection of particular color paints and their subsequent productions. Positive and significant correlations were obtained between the responses of the three techniques. The experiment suggests that all the three techniques measured color preference.

Two investigations have used crayons to determine color preference, Coyle and Eisenman (1970) presented to white and negro children with large outlines of Santa Claus and asked the subjects to fill them with crayons as they wished. The results showed that both negro and white children, colored Santa Claus with caucasian faces, but there was a difference in the colors of crayons used. The influence of culture is demonstratively expressed. Despite some outlines and some caucasian faces colored, there were differences in the colors of crayons used according to each culture. Negro children used preferably white and black, whereas white children used red or white preferably.

Nelson et al (1971) were the first investigators to devise a way of quantifying color preferences. They assessed preferences by the "weight-abrasion" method. Crayons which had been trimmed to the same weight were used to draw by school children belonging to five cultures, namely: Alberta Indians, Northwest Territories Indians,



Hutterites (German colony), secular "white" and Roman Catholic "white". Crayons were reweighed after the drawing and the weight difference used as a measure of preference. The results showed that there were significant cultural differences in the amount of weight of crayons used. The Hutterites and Northwest Territories Indian children used the least amount of crayons whereas the urban secular "white" used the greatest amount. They also found that the culture and color of crayons interacted significantly and that cultural isolation is reliably related to the total weight of crayons used. As demographic indices of cultural isolation increased, cultural color preferences decreased.

#### Subject characteristics

Age: Several studies report a preference for yellow and red in young children, which gradually gives away to preference for blue and green in later years of childhood and adulthood (Ellis 1900, 1906, Holden and Bousse 1900, Marsden 1903, Myers 1908, Katz and Breed 1922, Staples 1932, Gale 1933 and Staples and Walton 1933). The generalization that there is a change in preference from the "warm" to the "cool" hues is not borne out cross-culturally (Garth et al 1931, Garth et al 1938, Imada 1926, Shen 1937), even for the young "white" children purple and violet are rarely preferred, while





the position of red remains high in the scale of preference regardless of age (Jastrow 1897, Garth 1931, Tinker 1938, Eysenck 1941). In general, the effect of age on color preference is to lower the preference of yellow (it is second to white among the least preferred by older children and adults) and to gradually raise the preference of blue, until it assumes top position.

Sex: Ellis (1900) and Staples (1932) find that the development of color preference is more precocious in girls than in boys, but that the latter catch up in adolescence. The color preference of women has been reported to be more variable by Jastrow (1897), Hirohashi (1926), Walton, Guilford and Guilford (1933) and Guilford and Smith (1959). Only three studies find significant differences between the sexes (Mercer 1925, Warner 1949, and Choungourian 1968). Warner reports differential preference of hues, chroma and value between the sexes for the psychotics, while Mercer and Choungourian report differential preference of certain colors.

On the other hand, a number of investigations find sex of little importance as a color preference determinant (Garth 1922, Gesche 1927, Katz and Breed 1922, St. George 1938, Eysenck 1941, Granger 1955, and Nelson et al 1971). The correlations between the



sexes that are reported (Shen 1937  $r$ : 893, Eysench 1941,  $r$ : 0.95) are so high that they indicate no differences between the sexes.

While the order of preference is apparently not a function of sex, there is ample evidence to suppose differences in strength and variability of color preference between the sexes.

Personality: The investigations of color preference and personality show least consensus. The lack of common findings by different investigators can be attributed to the lack of controlled experimentation, inadequate sampling and lack of statistical treatment of the data.

Katz' (1931) report that the preference of psychotics is comparable to the normal is contradicted by Strenski et al (1970) who find that the orders of color preference of normal and psychotic are significantly different. Katz' other finding that the psychotics prefer "warm" colors is partly supported by Shihiba (1927). Strenski et al (1970) find no tendency for schizophrenics to prefer blue or "cool" colors as Birren (1962) and Block and Caldwell (1959) report, and that bright colors are not preferred by schizophrenics as Feamster (1960) finds. No significant relationship between affect and color



preference of schizophrenics is reported by Block and Caldwell (1959) and Choungourian (1967) finds only a tendency for introverts to prefer "cool" colors and the extraverts to prefer "warm" colors. Warner (1949) reports the only statistically significant finding that neurotics prefer green to yellow and that they prefer light colors to dark colors. Better controlled and adequately-sampled experimentation is required before the effect of personality on color preference can be assessed.

Culture: Factors that influence cultural color preference are great but this should not obscure the general relationship of preference to color. It is also possible to attribute much of the differences to nurtural factors rather than to nativistic ones. Figure 1 shows the scattergram of color preferences of eight cultures. At a "gestalt" glance, there seems to be hardly any uniformity, but by taking a median of the affective value of each color, a linear relationship between colors and affect or appreciation emerges. Red is the only exception to this linearity. Similar results were obtained by Eysenck (1941) who averaged preferential orders of 24 investigations instead of affective values.





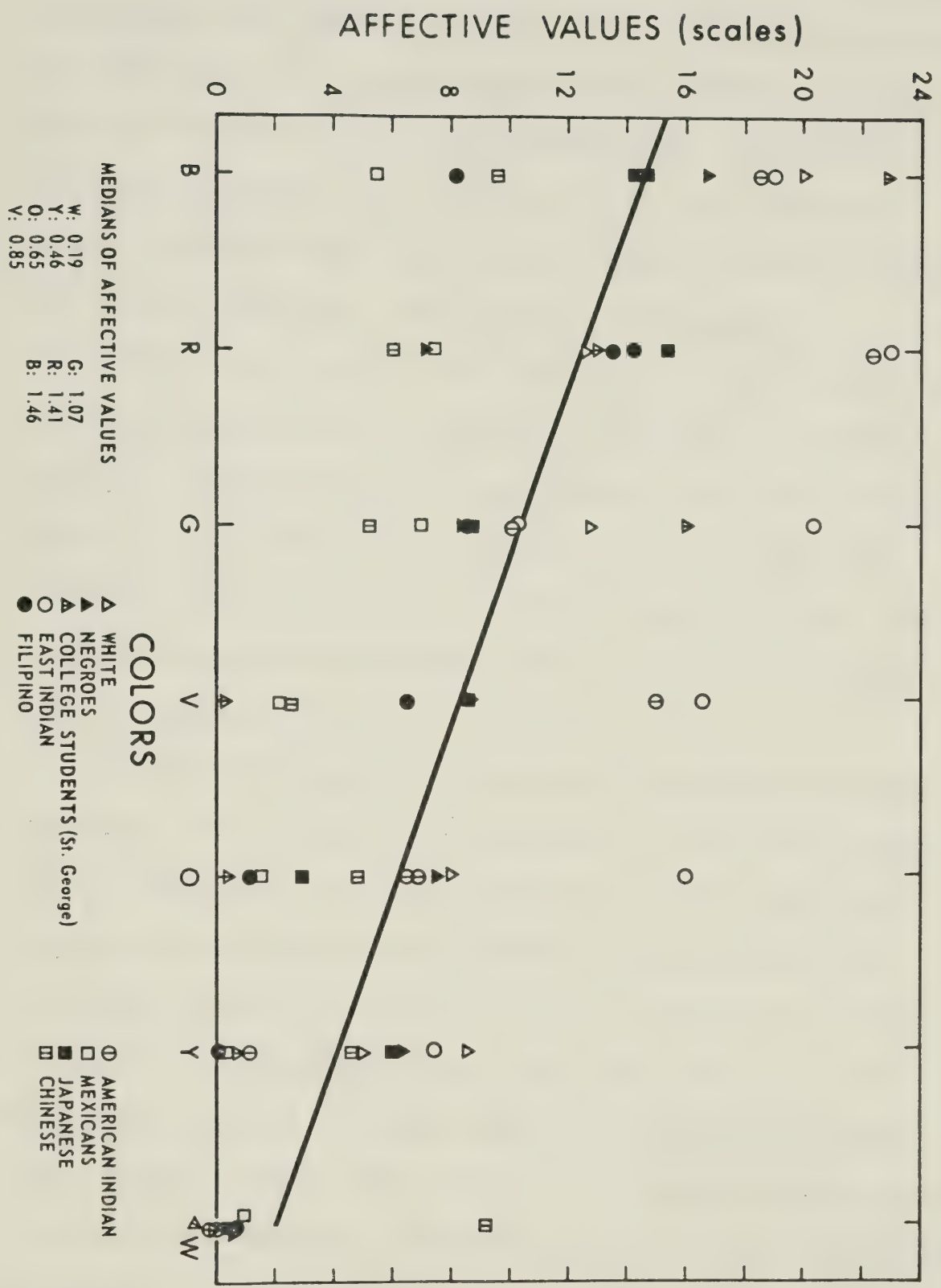


FIGURE 1 THE RELATIONSHIP BETWEEN AFFECT AND COLOR



Preferences of colors, as measured by scales were correlated and Table 1 shows these correlations between the preference of "white" culture and other cultures. With the exception of the Chinese whose correlation is low and negative, the rest have high correlations, which indicates that color preferences across cultures are fairly similar. The Negroes, belonging to a sub-culture of the "white" have the highest correlation and also worthy noticing is that preferences of Japanese, Negroes, and East Indians and "white" are more similar to each other than the color preference of "white" children and "white" adults, which suggests that color preferences across cultures may be more similar than color preference within a culture.

Further examination of cultural color preferences reveals a fair amount of similarity. Mexicans (Gesche 1927), American Indians (Garth and Collado 1929) and Japanese (Garth et al 1931) have a pattern not too different from the "white" with red preferred to blue and green. Generally, blue, red, and green are the most liked colors, whereas white and yellow are the least liked colors. But among the Chinese and Japanese high school students, there is an unusual and unexplained preference for white above all colors. (Chou and Chen 1935, Garth 1931, Hirohashi 1926, and Shen 1937). Both





Table 1

Correlations of scales of color preference  
between "white" culture and other cultures.<sup>o</sup>

| Culture                                    | Correlations    |              |
|--------------------------------------------|-----------------|--------------|
|                                            | School Children | Grade I      |
| American Indians                           | 0.776           | 0.880*       |
| Chinese                                    | -0.076          | Not Included |
| "White" College Students (St. George 1938) | 0.809           | -----        |
| East Indians                               | 0.830           | 0.971        |
| Filipino                                   | 0.646           | 0.866        |
| Japanese                                   | 0.822           | 0.896        |
| Mexicans                                   | 0.705           | 0.719        |
| Negroes                                    | 0.963           | 0.916        |

\* Grade Four's scale was used.

o The scale values of the same colors were correlated.



Garth (1931) and Hirohashi (1926) found the tendency towards white preference developing in late grade school years reaching greatest prominence in normal school boys and high school instructors. The generality of this peculiar tendency might be doubted, since Mizugushi and Aoki (1926) found a preference ranking much closer to that reported for "whites".

Color preference of younger children of different cultures display even greater similarity between "white" grade one children and children of similar grade belonging to other cultures, are shown in Table 1. Except for Negroes, correlations of color preferences of grade one's are higher than the correlations for the rest of the school. Obviously, differences in cultural color preferences increase with age. Most probably, these differences are due to nurtural factors such as tradition, language, and esthetic ideals of the culture, which are kept alive from generation to generation.

Specific cultural function and societal needs and settings are associated with certain colors. For example, "white" is the color for the bride's wedding dress and "black" is a funeral and mourning color in the "white" culture. Surprisingly, "white", the favorite color of the Chinese, is also their mourning color. Ross' (1938) elaborated investigation of the effect of



color in the western theatre requires similar cross-cultural studies to conclude whether these findings are only stereotypical of the "white" culture. He found that high illumination is associated with "hot", "active", and "comic" scenes, whereas low illumination is associated with "emotional", "tense", "tragic", "melodramatic" and "romantic" scenes; and that high chroma is linked with dramatic episodes labelled "emotional", "tense", "hot", "comic" and "melodramatic". He also found that hues considered "red", "orange", and "yellow" are associated with "activity" and "comedy" and that those judged "green", "blue", "violet", "purple", and "grey" with "tragedy" and possibly "romance".

### The Generality of Color Preference

Two opposing views are held regarding the basis and generality of color preference -- the subjective and the objective. The extreme subjectivists (Cohn 1894, Michaels 1924 below age 6, Dorucs 1926 and Dunlop 1930), deny the existence of color preference, emphasize the chaotic diversity of preference and maintain that the results are too variable to justify any generalization of color preference. The rest of the subjectivists (Washburn 1911, Mercer 1925, Slade 1925, Lillie 1926, Garth et al 1931, Chou and Chen 1935 and Choungourian 1968) attribute the order of color preference to social





conditioning such as conventional and cultural associations. They argue that the gross agreement of color preference within groups and races is largely due to the common social influences. Successful attempts of conditioning and reversing preferences (Staples and Walton 1933, Khozak 1934, Kovsharova 1934 and Peters 1943) support the subjective view.

The extremists among the objectivists (Garth 1922, Eysenck 1941, Rodriguez 1950 and Granger 1955) claim that color preference are objectively or biologically or nativistically determined. They assert that color preferences are dependent on a more fundamental aesthetic factor and are independent of personal tastes and largely dependent on the objective stimulus properties. The findings by Eysenck (1941) that averaging seventeen orders of color preference yield one linear order, the linearity between color and affect (Figure 1) and the high correlations between color preferences of various cultures (Table 1) support the extreme objective view. The rest of the objectivists (Garth and Collado 1929, Garth, Skeda, Langdon 1931, Walton, Guilford and Guilford 1933, Garth, Moses and Anthony 1938, St. George 1938) assert that color preference is determined by biological and environmental factors. The common findings that color preferences of young children are very similar but that



of the adults are fairly different seems to support the moderate objective view.

Staples and Walton (1933) suggest that color preferences have a physiological basis, but that as development progresses, social conditioning becomes the basis of preference. The present writer suggests that color preferences are either objective or subjective depending on the processes involved. When color preferences are perceptually determined (based on physical stimuli e.g. brightness, dullness), they are objective; when they are conceptually determined (based on likes or dislikes of specific objects e.g. colors of cloth, cars, houses), they are subjective.





### Hue Coding and Memory

Theorists differ as to what is the origin of language and its relation to thought. Piaget (Inhelder et al, 1966) suggests that the child's mental operations do not progress through linguistic communication, and that the meaning of language is not likely acquired from environmental sources, but is mentally constructed (assimilated) by the child as an expression of internal schemas.

Whorf postulated a different hypothesis which has been systematized by Fishman (1960). The first level established a relationship between linguistic codability and cultural factors. This is the weakest level in the sense of being least creative or least novel. At this level of analysis language differ in the same ways as the general cultures or surrounding environments of their speakers differ. The often quoted example pertaining to this level is the fact that the Eskimo has many words for different kinds of "snow" whereas English has only two. Analogously languages categorize and name colors differently: Navaho does not have separate highly codable terms for "blue" and "green" but do have separate terms for different shades of "black".

The second level relates linguistic codability to behavioural concomitants: an illustrating example is



given by Brown and Lenneberg (1954). This will be reviewed in another context.

The third level establishes a relationship between linguistic structure and culture: Whorf (1940) was, for example of the opinion that the absence of tenses in Hopi indicates that the outlook on life is timeless and ahistorical.

The fourth and last level relates linguistic structure to behavioral concomitants: Carrol and Casagrande's (1958) experiment is the best example. The subjects, monolingual and bilingual Navahos, were presented with a pair of objects which differed by either color or shape, and then a third object which had similar and relevant characteristics to each member of the original pair. They were asked to indicate which member of the pair went with the third. As the Navaho verbs of "handling" require an inflection appropriate to the shape of the object handled, the Whorfian hypothesis would predict that shape of the object should develop earlier among the monolingual Navaho children compared to bilingual Navaho children. The results fulfilled the Whorfian hypothesis.

Let us turn now to work dealing more directly with color. Colors are known to differ in their codability within a single language. Colors that are



near the boundary of a naming category are less codable than those lying well inside the category. Chapanis' (1965) study of color naming found a large region between most of Munsell greens and the blue-greens which was not sampled at all by color names and almost complete synonymy between violet and purple and between yellowish green and yellow-green. A survey by P. Evans reported by Evans (1948) of seventeen best sellers (novels), disclosed the fact that of the total of 4,416 color terms used, 4081 are accounted for by only 12 terms.

A series of experiments studying the influence of language on color memory and recognition were performed by Brown and Lenneberg (1954). In the first part of the experiment, they measured codability with a number of indices: length of name given to color, naming latency, and inter-subject agreement. These measures correlated highly, supporting the notion of general codability factor. It was hypothesized that this codability would be correlated with recognition accuracy. More specifically, they hypothesized that the easier it is to name a color, the easier it will be to remember it. In the second experiment, one or more colors were presented to the subjects, then removed after a time interval. The subject was asked to select the color seen earlier from a large array of





colors. The findings were that when the task was easy (i.e. one color to be remembered after seven seconds), codability was not highly correlated with recognition accuracy, but as the task became more difficult (four colors to be remembered after three minutes), the two began to correlate, and the relation was strongest when the task was most difficult.

Brown and Lenneberg also report a study by Lenneberg and Roberts, who conducted the same experiments but employed Zuni Indians as subjects. Results obtained were similar, despite considerable differences in color terminology between the two languages. Differential codability was demonstrated. For example, the colors called "orange" and "yellow" are coded with a single term in Zuni, consequently monolingual Zunis frequently confused orange and yellow colors in the recognition tasks, whereas English-speaking Zunis never made this kind of error.

Burnham and Clark (1955) measured color memory, using Farnsworth-Munsell colors. Single color chips were shown for five seconds, and then, after a five second waiting period, a subject was asked to find the color from among thirty-six colors that could be now viewed in rapid succession. The recognition accuracy of the colors in their study was negatively correlated



with codability, in contrast to the positive correlation obtained by Brown and Lenneberg.

This apparent contradiction was considered by Lenneberg (1961) who concluded that it is not merely "high codability" that facilitates recognition but the habit of structuring color material semantically which provides a number of anchoring points in the recognition task. In the Burnham and Clark's study where the experimental stimulus universe was such that the majority of its constituents would not be labelled unequivocally by precise color terms, low communality provided the anchoring color points, whereas high communality, precise color terms, provided the anchoring points in Brown and Lenneberg's investigation.

This analysis showed clearly the need for a better linguistic measure to predict nonverbal behavior. Such a measure was proposed and tested by Lantz and Stefftre (1964). They reasoned that the better the individual communicates the stimulus to himself, the better he remembers it. Extending intrapersonal to interpersonal communication, they operationalized a new linguistic measure, termed "communication accuracy". This was obtained by asking subjects to make up a description of colors that would enable another person to pick them out of an array of colors. Then these descriptions were





given to another set of subjects to use in the selection of colors. Finally, Lantz and Stefftre conducted the recognition experiments with the stimulus array discussed above. They found that communication accuracy correlated positively with recognition accuracy in both arrays, whereas codability correlated positively with recognition accuracy for the Brown and Lenneberg array, and negatively for the Farnsworth-Munsell series.

Probably certain hues and values have high communication accuracy because Collins (1931) and Hamwai and Landis (1955) found that certain hues and values are recognized more easily than others and Bernback (1967) found that labelling with colors facilitated recognition task among nursery school children.

Lantz and Lenneberg (1966) also investigated the quality of language system required for this kind of cognitive performance. They replicated the parent experiment using deaf and hearing children and adults. All groups except deaf children were given a communication accuracy task, and then the recognition task. As expected, the group best equipped with language skill performed best. The order was: hearing adults, hearing children, deaf adults and then deaf children. Communication accuracy appears to be a good predictor of recognition accuracy.



Another investigation was conducted by Dale (1969) using children between the ages of three and five years. Children were defined on the basis of age as egocentric, idiosyncratic, and as having a linguistic system that is still in development. The children were given a perceptual task (color matching), a memory task (color recognition), and a labelling task (color naming). The experiment demonstrated a relation between the name given to a color and the way the color was manipulated in other tasks. Nearly all the matching and recognition responses, even when naming was incorrect, were colors to which the child had given the same name as the stimulus color. All subjects showed this tendency in the matching task, while only those who spontaneously named the colors as they were presented showed this effect on this recognition task.

To explain the correlation between the matching task and color names, since no memory was involved, Dale speculated that there are two processes involved, namely covert naming and rehearsal and that covert naming and rehearsal are both required in color recognition.



### Brightness Contrast

Besides hue, brightness contrast or the relative brightness between the figure and the ground, probably influence the quantity and quality of colors used. Rubin quoted by Bearslee and Wertheimer (1958) reported that he had noticed in many different situations that color seemed more "substantial" and more "compact" in the figure than in the ground and that Katz had had the same impression in several experiments.

Helson (1964) postulates that there are two ways by which the backgrounds influences the object colors. Firstly, by modifying object colors through simultaneous contrast or assimilation, and secondly, by the kinds of combinations they make with the object colors. He points out that the effect of contrast might be so great that the object colors might be perceptually changed in lightness and chromaticness as the result of the presence of other colors in the neighborhood.

He investigated the effectiveness of five backgrounds (3000K, 4500K, 2854K, and 6500K, the first three were fluorescent and last two were incandescent) by evaluating the average ratings of one hundred and twenty-five different Munsell colors in each background. On the basis of the experiment, he concluded that certain background color appeared again and again.





White background was rated first four times in four sources of illumination and third in the fifth source, green was rated third three times; and yellow was rated fourth in five sources. Surprisingly, black was rated third in one source (6500K filament). The experiment demonstrates that certain backgrounds are more effective in allowing certain colors to stand out.

### Problem

The present research examines Nelson's et al (1971) speculations that color preference may shift as the background varies in either value, chroma or hue. Color preference is assessed both by visual appreciation (actual colors) and self-expression (weight-abrasion) methods and the relationship between the two preferences is established. The affective themes of the drawings are also assessed.

The following are the hypotheses tested.

1. The amount of a particular color used will vary as a function of lightness contrast. In general the less the value of the drawing paper, the more color (amount in weight of crayons) required for the figure (drawing) to stand out.
2. The amount of a particular color used will vary as a function of chromatic contrast.
3. A reliable relationship (correlation) exists



between color preference as tested with actual colors and the amount of crayons of these colors used.

4. The two preferences (actual colors and weight abrasion) are related.





## Method

### Subjects

Two hundred and fifty-six grade two and grade five boys and girls of the Edmonton Elementary Public School System, served as the subjects. The schools were on the outskirts of this particular metropolitan area of about four hundred thousand people. All the subjects were caucasians and belonged largely to middle class families. The average age of grade two was seven and a half years and that of grade five, ten and a half.

### Apparatus

Nine Munsell color papers, whose specifications are given in Table 2, were used to test color preference and to assess codability or test for the names of colors. Each paper was four inches by five and half inches. Except for a circle of three inches in diameter, the rest of the paper was covered with a medium gray paper. These colors are representative of Chapanis' (1965) circle and five out of nine colors used were easy to name according to Chapanis.

Nine, medium-sized wax color crayons (.3" in diameter x 3.5" length) were used in the drawing part of the experiment. The colors of the crayons were the same as the colors of the Munsell color paper.



| Color of Crayon or Paper | Munsell Hue | Munsell Chroma | Munsell Value | Lightness Contrast White | Lightness Contrast Light Grey | Lightness Contrast Dark Grey | Light Contrast Black |
|--------------------------|-------------|----------------|---------------|--------------------------|-------------------------------|------------------------------|----------------------|
| red                      | 5R          | 14             | 4             | 5                        | 3                             | 1                            | 2                    |
| orange                   | 2.5YR       | 16             | 6             | 3                        | 1                             | 1                            | 4                    |
| yellow                   | 5Y          | 14             | 8.5           | .5                       | 1.5                           | 3.5                          | 6.5                  |
| green                    | 2.5G        | 12             | 5             | 4                        | 2                             | 0                            | 3                    |
| blue                     | 5PB         | 12             | 5             | 4                        | 2                             | 0                            | 3                    |
| purple                   | 10P         | 12             | 5             | 4                        | 2                             | 0                            | 3                    |
| orange-yellow            | 10YP        | 14             | 8             | 1                        | 1                             | 3                            | 3                    |
| turquoise                | 5BG         | 8              | 7             | 2                        | 0                             | 2                            | 5                    |
| light green              | 7.5G        | 10             | 6             | 3                        | 1                             | 1                            | 4                    |
| white                    | neutral     | 0              | 9             |                          |                               |                              |                      |
| light grey               | neutral     | 0              | 7             |                          |                               |                              |                      |
| dark grey                | neutral     | 0              | 5             |                          |                               |                              |                      |
| black                    | neutral     | 0              | 2             |                          |                               |                              |                      |



When the value of the drawing paper changed from white to black, different crayons were used to keep the colors of crayons and that of Munsell paper the same. As loss of crayons weight served as a measure of color preference, each crayon was weighted in grams to a precision of three decimal places with a chemical electric balance. Nine crayons of the same colors as the Munsell colors and a label were bundled. The label carried the number of the bundle and specified the color of the drawing on which the crayons were to be used. It had space where age, sex, and names would be written.

The drawing papers used were approximately nine inches by twelve inches. Their Munsell specifications are given in Table 2. A label described above, was fixed at the back of the drawing paper and a piece of white paper was stapled below this lable.

### Procedure

The experiment consisted of two parts -- color naming or preference choicing and drawing. The first part was administered to each individual subject in well-lit rooms. After a subject was screened for color-blindness with pseudoisochromatic plates and his names recorded, he sat at a table on which nine Munsell color papers were spread out randomly in two





rows. If he was in the naming group, he was instructed "Here are nine papers of different colors, what I want you to do is to name them. Keep in mind that each colored paper has a different name". If a subject gave the same name to more than one color, he was confronted with these colors and he had to rename them. He put each colored paper aside after calling its name. The name or names given were recorded by the experimenter.

A subject in the preference group had the same experimental set-up, but was instructed, "Here are nine papers of different colors and I want you to pick up your favorite color -- the color you like best, then the second favorite, and go on until the ninth". The colored papers that were picked up were placed aside. The order of preference was recorded by the experimenter.

Drawing, the second part of the experiment was conducted in classrooms. The experimenter passed out a drawing paper and a bundle of crayons to each subject. Then, the experimenter instructed the subjects, "During the next twenty minutes, I want you to draw or to color an event -- something that happened to you that you will never forget even if you live to be hundred and one. You may use any one of the crayons as you wished".

When twenty minutes elapsed, the subjects were



instructed to write their ages, sex, on the labels at the back of the drawing paper, and to write the same on the labels that were wrapped around the bundle of crayons. They were also instructed to write a title or a short story of the drawing on the piece of papers that were stapled below the labels. The bundles of crayons and drawing papers were collected.

Thematic content of each drawing was judged employing Rychlak's (1960, 1967) scheme for describing dream themes. The affiliative, reward, and tension terms are defined as follows (Rychlak, 1960):

Affiliative: Themes having relaxed or pleasurable interpersonal relations with other human beings as their major content, regardless of the latter's relationship to S, e.g., relatives, peers, same or opposite sex, etc. There must be some form of interaction with the person, and not simply a recollection of seeing him.

Reward: Themes whose major content involves a positive, pleasurable connotation, other than that derived from strictly interpersonal contact. Reward themes include individual achievement and recognition, the receiving of gifts, and any phantasy-like tale of miraculous happenings.

Tension: Themes reflecting anxiety, frustration or hostility as their major content.

Thematic contents were ascertained by ratings made by three experimenters. Each judged drawings independently of each other. Each story was judged



along all three dimensions. When the three judgements differed, differences were resolved by an open discussion and then an agreement was reached.





### Result

Color preference as measured by loss of weight of crayons, caused by drawing abrasion was subjected to a factorial analysis. The factors were age, sex, color preference or naming, colors of crayons and color of the drawing paper. Each subgroup had eight subjects and each subject drew with nine crayons.

It is apparent from Table 3 that age was a significant factor. Grade five used, on the average, more amount of crayons (five milligrams) than grade two. Neither sex nor naming or preference was a significant factor. The color of the drawing paper was almost a significant factor at five per cent level. Figure 2 shows that up to a certain point, the weight of color used increased then decreased as the value of the drawing paper decreased. (Hue and chroma of the paper were neutral and zero respectively.) Correlations between chroma, lightness contrasts and weight of crayons, shown in Table 6, are low and not significant. Thus, the first and second hypotheses that the amount of color used will vary as a function of lightness contrast and as a function of chromatic contrast were not supported.

The colors of crayons were a significant factor at one per cent level. Beginning with the colors of







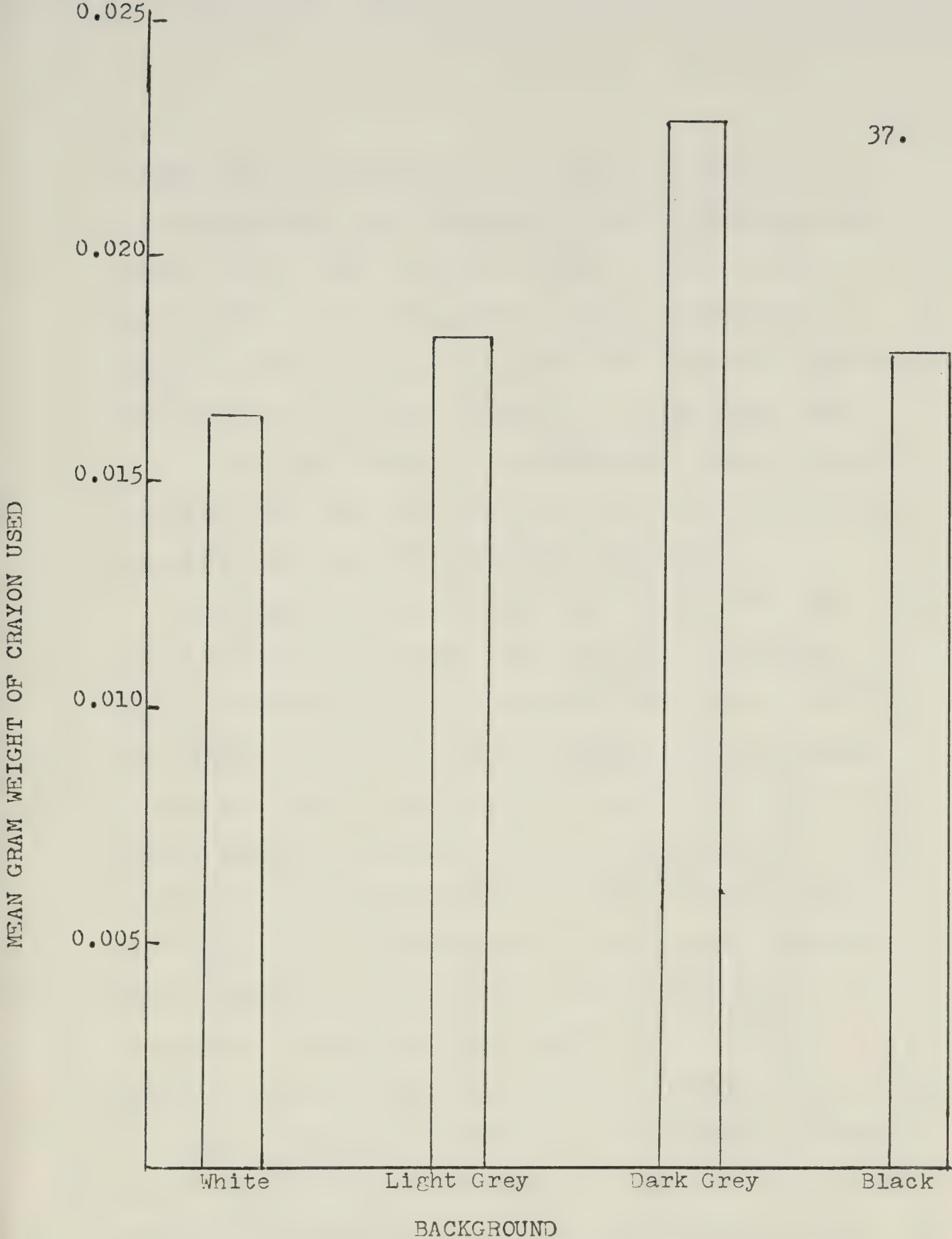


FIGURE 2 LOSS OF WEIGHT OF CRAYONS ON EACH VALUE (COLOR) OF DRAWING PAPER





crayons that lost the greatest amount of weight, or color preference, as assessed by the "weight-abrasion" method, was: blue, turquoise (light blue), yellow, light green, red, dark yellow, orange and purple.

Duncan's test revealed that only blue was used significantly more than all the other colors at one per cent level.

At five per cent level of significance, green, yellow, turquoise, and blue were used more than purple, and also turquoise and blue were used more than orange.

The only interaction that was significant was between colors of crayons and values of the drawing paper. Graphing it, as illustrated in Figure 3, did not reveal any generalization, except that the amount of crayons used on each value of the drawing paper was proportional to the total amount of crayons used. Dark yellow and turquoise were the outstanding exceptions, with these colors the amount of crayon used increased then decreased as the value of the drawing paper decreased. Light green and yellow were generally avoided on black paper and blue was maximally used on it.

Color preferences determined using actual colors, of the whole group and according to ages and sexes are displayed in Table 4. Sex seemed to influence color preference. Purple which was the girls' favorite color, was fourth for the boys. Green and blue



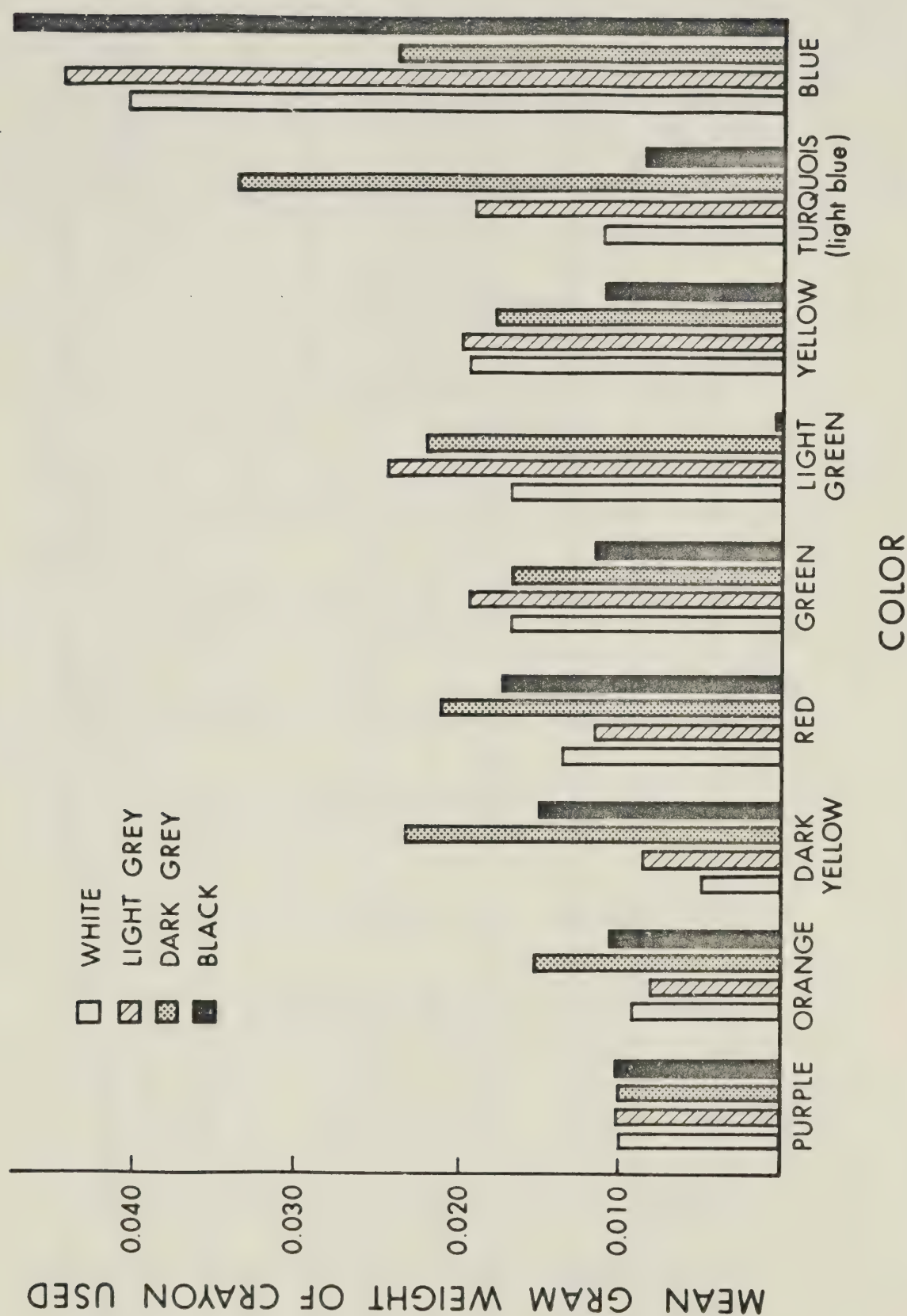


FIGURE 3 LOSS OF WEIGHT OF EACH COLOR OF CRAYONS ON EACH VALUE (COLOR) OF THE DRAWING PAPER.



Table 4

## Color Preference

| Color          | Preference | Preference<br>Grade 2 | Preference<br>Grade 5 | Preference<br>Girls | Preference<br>Boys | Preference<br>By "Weight-<br>Abrasion" |
|----------------|------------|-----------------------|-----------------------|---------------------|--------------------|----------------------------------------|
| red            | 3          | 2                     | 3                     | 2                   | 3                  | 6                                      |
| orange         | 5          | 5                     | 5                     | 5                   | 5                  | 8                                      |
| yellow         | 6          | 7                     | 6                     | 6                   | 6                  | 3                                      |
| green          | 2          | 4                     | 2                     | 3                   | 1                  | 5                                      |
| blue           | 4          | 3                     | 4                     | 4                   | 2                  | 1                                      |
| purple         | 1          | 1                     | 1                     | 1                   | 4                  | 9                                      |
| dark<br>yellow | 9          | 8                     | 7                     | 8                   | 7                  | 7                                      |
| turquoise      | 8          | 6                     | 8                     | 7                   | 8                  | 2                                      |
| light<br>green | 7          | 9                     | 9                     | 9                   | 9                  | 4                                      |





which were first and second among the boys, were third and fourth respectively among the girls. However, both sexes agreed in having light green as their least preferred color. The order of preference for the whole group, beginning with the most preferred color is: purple, green, red, blue, orange, yellow, light green, turquoise, and dark yellow.

Color naming or codability was defined as: the largest number of subjects who responded with the same name to a given color, minus the number of subjects who responded with different names divided by the number of subjects in each group. As shown in Table 5, the younger subjects (grade two) were more consistent in naming colors than the older subjects. Girls also tended to code colors better than boys. These differences were not significant ( $t=0.554$  for ages and  $t=0.426$  for sexes, where at  $p < .05$   $t=1.64$ ).

Correlations were computed between the two preferences and between preference (as tested with actual colors) and codability and their interactions with crayons, ages, and sexes (Table 6). The correlation between the two preferences is negative ( $r: -.316$ )<sup>1</sup>. This means that the two methods do not test the same color

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1 See appendix.



Table 5

## Codability

| Color          | Codability | Codability<br>Grade 2 | Codability<br>Grade 5 | Codability<br>Girls | Codability<br>Boys |
|----------------|------------|-----------------------|-----------------------|---------------------|--------------------|
| red            | 26.5       | 27                    | 27.5                  | 28                  | 26.5               |
| orange         | 26         | 27                    | 26                    | 26.5                | 25.5               |
| yellow         | 10.75      | 16                    | 12.5                  | 16                  | 10.5               |
| green          | 10         | 12                    | 11                    | 14.5                | 9.5                |
| blue           | 18.25      | 24.5                  | 18                    | 21                  | 21.5               |
| purple         | 16.5       | 19.5                  | 15.5                  | 22                  | 13                 |
| dark<br>yellow | 2.5        | 7                     | 3                     | 10.5                | 4.5                |
| turquois*      | -8.5       | 0                     | 1                     | -4.5                | 1                  |
| light<br>green | 12.5       | 12                    | 6                     | 7.5                 | 9.5                |

\* Named light-blue by Grade 2.



preference.

The correlation between the amount of crayons used and codability was very low ( $r:0.0229$ ). Therefore the fourth hypothesis was not supported. The only high correlation was between preference and codability ( $r:-.607$ ). As preferred colors were designated with low numerals whereas better coding resulted in bigger numbers, the correlation was negative. With the exception of purple, the five colors (red, orange, yellow, green and blue) that were defined (Chapanis 1965) as being easy to name were preferred to the others (dark yellow, turquois, and light green) which were defined as being difficult to name. Table 5 bears out this relationship.

Computations of correlations between codability, preference and crayons, as shown in Table 6, indicated that grade two tended slightly to use crayons that they preferred and those that were easy to name (both  $r$ 's were 0.1). And that boys had a slight tendency to draw with colors that were easily coded ( $r:0.207$ ) whereas the girls tended not to employ the colors of crayons that they preferred ( $r:-0.22$ ).

Thematic contents of the drawings by ages and sexes are shown in Table 7. The analysis of the data with chi-square test, revealed that there were no significant difference ( $\chi^2 = 3.11$ ,  $p < .10$ ) between the





Table 6

Correlations between chroma of crayons, values of backgrounds and crayons, and between preferences and codability and their interactions.

| Interactions                                          | Correlations |
|-------------------------------------------------------|--------------|
| Chroma x crayons (weight)                             | - 0.24       |
| White x cray.                                         | 0.259        |
| Light grey x cray.                                    | 0.066        |
| Dark grey x cray.                                     | 0.335        |
| Black x cray.                                         | - 0.330      |
| Preference (visual) x<br>Preference (weight abrasion) | - 0.316      |
| Pref. x codability                                    | - 0.607      |
| Pref. x cod. x grade 2                                | - 0.582      |
| Pref. x cod. x grade 5                                | - 0.595      |
| Pref. x cod. x girls                                  | - 0.683      |
| Pref. x cod. x boys                                   | - 0.544      |
| Pref. x cray.                                         | - 0.011      |
| Pref. x cray. x grade 2                               | - 0.105      |
| Pref. x cray. x grade 5                               | 0.001        |
| Pref. x cray. x girls                                 | - 0.223      |
| Pref. x cray. x boys                                  | - 0.064      |
| Cod. x cray.                                          | 0.023        |
| Cod. x cray. x grade 2                                | 0.102        |
| Cod. x cray. x grade 5                                | 0.075        |
| Cod. x cray. x girls                                  | - 0.008      |
| Cod. x cray. x boys                                   | 0.207        |



Table 7

## Analysis of the Affective Themes

| Affective Category     | Grade 2                        | Grade 5 | Girls | Boys  |
|------------------------|--------------------------------|---------|-------|-------|
| Affiliative            | 9.88                           | 7.26    | 8.94  | 7.81  |
| Reward                 | 45.93                          | 35.66   | 43.20 | 39.02 |
| Tension                | 44.41                          | 56.36   | 47.92 | 52.85 |
| Age or Sex Differences | df = 2, $X^2 = 3.11$ $P < .10$ |         |       |       |
|                        | df = 2, $X^2 = 0.53$ ns        |         |       |       |

| Affective Category | Girls Grade 2                     | Boys Grade 2 | Girls Grade 5 | Boys Grade 5 | Age Differences                   |
|--------------------|-----------------------------------|--------------|---------------|--------------|-----------------------------------|
| Affiliative        | 12.42                             | 7.18         | 5.46          | 9.06         | df = 1, $X^2 = 2.2$<br>$p < .10$  |
| Reward             | 49.68                             | 42.18        | 36.71         | 35.85        | df = 1, $X^2 = 0.2$<br>ns         |
| Tension            | 38.04                             | 50.78        | 57.81         | 53.51        | df = 1, $X^2 = 1.64$<br>$p < .20$ |
| Sex Differences    | df = 2, $X^2 = 6.16$<br>$p < .05$ |              |               |              |                                   |
|                    | df = 2, $X^2 = 1.06$<br>ns        |              |               |              |                                   |



thematic contents of the young children (grade two) and the older children (grade five). The tendency was that young children showed more "reward" and "affiliative", whereas the older children had more tension.

The differences between sexes among young children were significant ( $\chi^2 = 6.16$ ,  $p < .05$ ) with respect to themes. The girls' order of themes was "reward", "tension", and "affiliative" whereas the order for boys was "tension", "reward", and "affiliative". The older children did not show this differentiation. Their order was the same as the younger males: "tension", "reward", and "affiliative".





### Discussion

Age, as a significant factor is partly explainable by the observations that young subjects tended to draw only the outlines of their drawings rather than color the whole drawing as the older subjects did. Possibly, the older subjects drew with more energy and pressure compared to the young ones.

With the exception of the black background, the amount of crayons used was linearly related to the value of the drawing paper. This means that as the background got darker, more amount of crayons were required to make the figure (drawing) stand out. Less usage of crayons on black paper is probably attributable to the lack of pronouncedness of colors on black drawing paper, the dislike of black (judged from subtle responses of subjects who received black papers), and the fact that black papers are not ordinarily used for drawing purposes.

Maximal use of blue on black paper requires an explanation as blue is hardly visible on black paper. Generally, children's use of colors reflected colors in real life. For example, water was drawn in blue, and the sun in yellow or dark yellow. Probably in an effort to make blue stand out and be visible on the black paper, more amount of blue crayons were used.



The observation that the colors used reflected actual colors in life helps to explain why color was a significant factor and why crayons were not significantly correlated to chromatic and lightness contrasts.

Because colors were differentially used as the actual colors of what was drawn required, regardless of chromatic and lightness contrasts.

Color preferences, as obtained with actual colors and as assessed with the "weight-abrasion" method which were hypothesized to be positively correlated, had a low and even negative correlation ( $r:-0.316$ ). This was unexpected because other modes and materials (Ames and Ilg, 1962, Haas 1963) that were used in testing for color preference yielded high correlations and similar orders of color preference. More investigations are required to assess whether both methods (actual colors and weight-abrasion) test for the same color preference.

If further investigations replicate our findings, it might seem necessary to recognize that there are at least three different "modes" of color preference, namely: actual colors, weight-abrasion and color-words. They bear a complex relationship to each other. For example, the "weight-abrasion" mode is likely to include colors that are not necessarily preferred abstractly or in isolation, but which are necessary to



create color-contrast or a better figure-ground relationships or light and shade or a realistic or non-realistic composition. This is exemplified by the findings of Ames and Ilg (1962) that black is the second preferred color and by Nelson et al. (1971) that white and black are the first and second colors of preference, respectively. With a visual method (actual colors), these colors are among the least preferred. Then "visual appreciation" methods test for colors that are preferred to look at, whereas "self-expression" methods test for colors that are preferred to use.

The order of color preference obtained by testing with actual colors is comparable to preferences found by other investigators except for greater and less preference of purple and blue respectively. Blue is usually the most preferred color but was fourth and purple was first. Little evidence is available to localize purple in the order of color preference. In the only study (Hurlock 1927) that included purple as testing stimulus, it was eighth (B, Pi, V, G, R, Cr, O, Pu, Br, Gy, Bk). As Hurlock studied color preference as a preference for color-words instead of actual colors, comparisons are less definite and certain. In accordance with numerous findings, saturated colors were preferred to unsaturated ones.





A tendency of grade two to name colors better than grade five was unexpected as older children are usually better equipped linguistically. This tendency might be, at least in part, attributable to the way naming was measured. Codability was operationally defined as intersubject agreement of color naming. The young children who are acquainted with only a few names of a given color, coded this color with these few names resulting in higher codability. On the other hand, the older children who are acquainted with many names of a given color, coded this color with many names. This resulted in lower codability.

Girls coded color better, had shorter latencies of color naming (observed not measured), and fewer girls than boys failed to name all the colors among the young subjects. This sex difference is probably due to more esthetic appreciation of colors, earlier color discrimination (Ellis 1906, and Staples 1932) and a generally better linguistic equipment of girls rather than boys.

Codability and preference did not influence the amount of crayons used. As already mentioned, children drew with colors that reflected actual colors in real life. In other words, their drawings were representative of the external world as they perceived



it, and not as they wished to perceive it.

The correlation between codability and preference is probably due to common and frequent usage of certain colors. Color preference was found to be highly correlated to the frequency of occurrence of these colors in the literature by Chou and Chen (1938  $r: +0.75$ ). This means that colors that are literally used frequently are preferred. Likewise more frequent literal use of given colors results in better naming. In other words, both preference and codability of colors are directly related to frequent use of certain colors.

For the affective themes, grade two had more "affiliative" and more "reward" and less "tension" than grade five. Similar findings were found by Barnes (1896) and Nelson et al. (1966) than "tension" significantly increased with age whereas "affiliation" reliably declined with age. Possibly the longer one lives the more one is exposed to tension producing situation.

The affective themes of young boys and older boys and girls are significantly more similar than the affective themes of young girls. Which perhaps means that young boys are acculturated to the norm affective themes more quickly compared to the young girls. But by grade five, the girls have caught up to the norm so that by then there are no sex differences.



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## Appendix

The fact that color preference as assessed by "weight-abrasion" method has three modes of appearance (surface, film and volume), whereas color preference tested with actual colors has only one mode of appearance (surface) necessitated a pilot study to investigate the effect of the background on color preferences.

The color preferences of forty grade-five children was tested as outlined in the procedure, except that instead of using Munsell color papers, white and black drawing papers were colored with crayons to produce the required colors. Table 1a shows the names of the resultant colors and color preferences<sup>1</sup> on different backgrounds. The white background had relatively little effect whereas the black background affected color preference so much that negative correlations (Table 2a) were obtained between "Munsell" and "black" and between "white" and "black." The pilot study remarkably demonstrates that investigations in color must be well-controlled, because a change in one peripheral variable (e.g., background) may result in very different findings.

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<sup>1</sup>The choices of each color were tested by Friedman two-way analysis of variance by rank. The results were significant at one percent level. This means that colors were chosen differently.



Table 1a  
Color preferences of grade five.

| Munsell             |            | White Background    |            | Black Background    |            | Weight-Abrasion |
|---------------------|------------|---------------------|------------|---------------------|------------|-----------------|
| Appearance of color | Preference | Appearance of color | Preference | Appearance of color | Preference | Preference      |
| red                 | 3          | red                 | 3          | light-brown         | 3          | 5               |
| orange              | 5          | orange              | 4          | dark-orange         | 8          | 8               |
| yellow              | 6          | yellow              | 7          | yellow              | 4          | 6               |
| green               | 2          | light-green         | 6          | dark-green          | 6          | 3               |
| blue                | 4          | dark-blue           | 2          | black               | 9          | 1               |
| purple              | 1          | light-violet        | 1          | dark-pink           | 1          | 9               |
| dark-yellow         | 7          | dark-yellow         | 5          | dark-orange         | 7          | 7               |
| turquoise           | 8          | sea-green           | 8          | turquoise           | 5          | 4               |
| light-green         | 9          | light-green         | 9          | leaf-green          | 2          | 2               |



Table 2a

Correlations between color preferences.

| Color Preference          | Coefficient |
|---------------------------|-------------|
| Munsell x White           | 0.783       |
| Munsell x Black           | 0.113       |
| Munsell x Weight-Abrasion | -0.267      |
| White x Black             | -0.133      |
| White x Weight-Abrasion   | -0.217      |
| Black x Weight-Abrasion   | -0.700      |

















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